REAL ESTATE ALLOCATION WITHIN THE DC LIFECYCLE:

A DYNAMIC APPROACH

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EXECUTIVE SUMMARY

Real estate investing has had a long history within defined benefit (DB) plans. For defined contribution (DC) plan sponsors, however, real estate represents a relatively nascent concept. The global shift from DB to DC retirement plans has provided an expanding investor base for real estate, with growth in cross-border investing since the recovery after the global financial market crisis almost a decade ago.

In our first paper, we identified the investment case for including an allocation to real estate in DC plans and recognized the following principal motivations for including real estate:

• Deterministic asset allocation strategies (target-date and balanced designs);
• Dynamic asset allocation strategies (dynamic lifecycle funds); and
• Sub-allocation strategies (varying exposures to public and private real estate over time).

Our results underscore the portfolio benefits of real estate in a DC context, particularly when considered through the outcome-oriented or goals-based lens of a multi-asset portfolio.

Our findings:

• In each of the designs, adding a 10% sleeve of real estate to portfolios (a fixed blend of half public and half private real estate) provides comparable median outcomes for diversified portfolios with a narrower distribution of retirement outcomes.
• The empirical results suggest that adding real estate is accretive to meeting or exceeding wealth accumulation objectives. In other words, plans that include real estate within their allocations have a higher probability of meeting or exceeding retirement wealth targets than those without real estate.
• Investment strategies with variable allocations to public and private real estate across the lifecycle may assist in managing risk over time.

Clearly, the destination matters more than the journey for DC plan participants. The risk of falling short of an appropriate, sustainable retirement wealth level (given some combination of contributions and portfolio returns) is the most important variable to manage. The results of this study suggest that incorporating the investment characteristics of core, institutional-quality real estate in a dynamic, outcome-oriented approach to DC plan design can improve the retirement security of DC plan participants over the long term.

MED, ANW & JMW

December 2016
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>2</td>
</tr>
<tr>
<td>1 Introduction</td>
<td>2</td>
</tr>
<tr>
<td>2 The Case for Real Estate Revisited</td>
<td>4</td>
</tr>
<tr>
<td>3 Data and Methodology</td>
<td>9</td>
</tr>
<tr>
<td>4 Asset Allocation</td>
<td>17</td>
</tr>
<tr>
<td>5 Results</td>
<td>25</td>
</tr>
<tr>
<td>6 Concluding Remarks</td>
<td>35</td>
</tr>
<tr>
<td>Reference List</td>
<td>37</td>
</tr>
<tr>
<td>Contact Details</td>
<td>44</td>
</tr>
<tr>
<td>Author Statement and Acknowledgements</td>
<td>44</td>
</tr>
</tbody>
</table>
1 INTRODUCTION
Defined contribution (DC) investing continues to increase in importance globally. Since late 2014 when we published our first paper in this series—A Path to Better Retirement Outcomes: Allocating Real Estate Assets to Retirement Portfolios (Drew et al., 2014)—retirement assets in the United States have grown in absolute (nominal) dollar terms from $19 trillion (or 113% of GDP) to almost $22 trillion (or 121% of GDP). Of this amount, the proportion of DC plan assets has grown further from 58% in 2014 to 60% in 2016 (Towers Watson, 2014; Willis Towers Watson, 2016a). Put simply, DC investing has increased in importance since we published our first paper in this series two years ago.

In our first paper, we identified the investment case for including an allocation to real estate in DC plans and recognized the following principal motivations for including real estate:

1. **Diversifying and Reducing Overall Portfolio Risk**
2. **Hedging Against Inflation**
3. **Stabilizing Cash Flows on a Relative Basis to the Portfolio in the Form of Rental Income**

Since then, the needs of investors have not changed. Investors still have a critical need to manage portfolio risk, hedge against inflation and ensure access to stable cash yields (especially in the retirement phase).

Several other themes remain of ongoing interest to retirement investors. The search for true diversifiers continues as investors seek to avoid the worst that equity markets have to offer, which is typically manifested in realized sequencing risk (Macqueen and Milevsky, 2006; Basu et al., 2012). Our earlier research paper presented evidence suggesting that allocating real estate assets to DC multi-asset portfolios could provide a path to better retirement outcomes. In this paper, we revisit the findings of the first paper with a longer data set, and extend the analysis in three important ways.

First, we consider the objective of DC plan sponsors to design an investment menu around four categories of asset classes: growth, defensive, alternatives and liquidity. Growth assets—typically represented by stocks—are critical to achieving retirement goals, but, unfortunately with their higher expected returns comes greater risk. Traditionally, in order to manage the risk of equities, investors have added lower correlated bonds. Bonds also bring to portfolios the benefit of having reliable cash yields. Depending on the nature of the investment objective, liquidity is, to greater or lesser degrees, also important. For this reason, DC investment designs typically include some amount of cash equivalents or stable value funds, especially in the retirement phase. Finally, investors may seek to diversify still further by adding nontraditional assets usually with the aim of reducing risk.

Second, we analyze how dynamic strategies perform both with and without real estate. In our first paper, we looked at a range of investment funds and strategies and found that the addition of real estate resulted in improved retirement outcomes in almost all situations. In this paper, we focus the analysis on dynamic, target-date strategies, modeling the

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1 While the dominance of DC investing hasn’t reached the levels of other countries—for example, Australia at 87% of the total (Willis Towers Watson, 2016a)—the trend is most certainly in that direction.
performance of these strategies both with and without the addition of public and private real estate. In doing so, we set out to test the case for real estate in an outcome-oriented paradigm.

Finally, we test time-varying allocations to real estate, whereas our earlier work maintained fixed allocations through time during the accumulation and retirement phases of the investment period. This is critical because we know that the dynamics of DC investing, and the reality of sequencing risk, means that the minimization of negative returns late in the accumulation phase is the best way to preserve retirement wealth. The last hypothesis we test is that, because of the low (measured) volatility of private real estate, higher allocation to this asset class should happen late in the accumulation phase in order to achieve an improved range of outcomes. In this last part of the analysis, we vary only the composition of the real estate allocation—i.e., the mix between public and private and not the level of the allocation. In this study, the composition remains fixed at 10%.
Real estate has a relatively long history as an alternative asset in institutional portfolios. Andonov et al. (2013), for example, highlighted the important role that real estate plays in institutional portfolios globally. It is the third-largest asset class for institutional investors and the most prominent alternative class (Willis Towers Watson, 2016b), suggesting the investment case for real estate is both sound and widely accepted.

Research suggests that real estate investments achieve the majority of investors’ expectations (Hudson-Wilson et al., 2005). Consistent with similar studies (e.g., Esrig et al., 2013), the first paper in this series found that DC multi-asset portfolios—such as target-date, target-risk or balanced strategies—with a relatively modest 10% allocation to an equally-weighted blend of public and private real estate:

- Achieved similar expected outcomes, and in some cases better results, when compared to portfolios without real estate;
- Did so with better risk characteristics (i.e., less tail risk); and
- Achieved success to a similar extent as their non-real estate alternative portfolios, but with a smoother path to success (Drew et al., 2014).

We remain convinced that this last point is particularly important for DC plan sponsors trying to design optimal multi-asset solutions for their plan participants. A portfolio strategy that delivers a smoother transition to success contributes to improved long-term participant behavior. In other words, it helps DC investors avoid adverse responses to temporary market setbacks such as switching out of risky assets or moving out of the market altogether after a significant market downturn. Our view continues to be that this smoother path increases the likelihood that participants will be better able to stick with their investment strategies regardless of market conditions; as a result, they will be more likely to achieve their long-term goals.

In fact, the search for a smoother path to success was the motivation fueling our continued research for this paper. We looked to examine whether:

- Real estate’s positive attributes extend to dynamic, target-aware strategies; and
- The nature (as opposed to the level) of real estate allocation affects portfolio attributes.

As the title of this study suggests, we are interested in a dynamic approach to allocating to real estate assets across the investor’s lifecycle. We now briefly recap the literature relating to lifecycle theory and dynamic strategies before fully diving into our thesis.

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1 Brounen et al. (2010) and Chun et al. (2000) found contrary outcomes when accounting for pension fund liability obligations.
LIFECYCLE ASSET ALLOCATION

While a comprehensive recapitulation of the literature will not be of great use in this context, a high-level summary may assist in placing this study within the context of the broader pension finance debate. Lifecycle theory—in a financial context at least—considers how an individual meets their lifetime liabilities (consumption requirements, shown in the yellow in Figure 1) through saving (i.e., deferring consumption) and investing (i.e., wealth creation).

At the risk of making sweeping generalizations, discussions about lifecycle theory are too often reduced to investment returns viewed through a time-weighted lens; that is, they are most interested in the brown series in Figure 1. As a result, financial professionals view all returns of a given level—say, 7% or -20%—as being equal whenever they are earned in the investing lifecycle. A generous interpretation of this tendency is that financial professionals know that they are responsible for one piece of the retirement saving puzzle (i.e., returns) and set about earning those returns on behalf of their collection of heterogeneous investors.¹

Figure 1: The Relative Importance of Factors that Contribute to Retirement Outcomes

Research has shown, however, that in a pension finance context not all returns are created equal. Because of the portfolio size effect—which is a function of the interplay between savings, returns and compounding (Basu and Drew, 2009)—real-world investors would prefer (whether they know it or not) a -20% return early, and the 7% return later in the savings journey rather than the other way around. Put another way, because of the portfolio-size effect, sequencing risk looms large in the late accumulation and early retirement phase of the investment lifecycle (see the blue series in Figure 1). In recognition of the heightened risks, and the amount of wealth at risk, this time has been described as the retirement risk zone (marked as between ages 55 and 75 in Figure 1). During the retirement risk zone, money-weighted returns—which capture the effect of returns on wealth—are of greater importance to retirement wealth (see the red series in Figure 1) (Bianchi et al., 2014).

¹ A cynical view would hold that financial professionals are guided by the incentives before them, which are usually confined to some narrow measure of investment success (e.g., active return versus a target, information ratio).
In terms of this study, the key question—but not the only question—is that of asset allocation over the lifecycle. At its essence, this question seeks to resolve how we might invest to achieve our desired retirement outcomes acknowledging the realities of pension finance briefly discussed above. Markowitz (1952) was the first to formally grapple with portfolio selection under uncertainty, with later research building on the essential insight of this seminal paper: diversification. The great economist Paul Samuelson, in a multi-period generalization of Markowitz (1952), investigated lifecycle asset allocation using an expected utility framework (Samuelson, 1969). He found that, assuming the investor exhibits constant relative risk aversion (CRRA), “... the optimal portfolio decision is independent of wealth at each stage and independent of all consumption-saving decisions leading to a constant [risky asset weight] w∗” (Samuelson, 1969, p. 244). Thus, if we believe Samuelson (1969), the optimal portfolio has a constant stock weight (w∗) that is a function of risk aversion, not time.

Others—for example, Kritzman and Rich (1998)—show that the optimal allocation to risky assets is highly sensitive to key assumptions in Samuelson (1969). For example, depending on the combination of asset return process and utility function assumptions, Kritzman and Rich (1998) show that the allocation to risky assets may be constant, may increase with time, or may decrease with time.

Insights from the scholarly research can be observed in investment options available to DC plan participants today. Historically, constant allocation target-risk designs (e.g., a 60/40 “balanced” option) were the investment choice du jour; today, a dizzying array of target-date fund designs are available in which the glide-path’s allocation to stocks (usually) has an inverse relationship with age (i.e., the allocation to stocks reduces as one ages/approaches the target retirement date). Downward sloping glide paths pay homage to lifecycle theory by implicitly acknowledging that the investor’s risk increases as retirement approaches (e.g., sequencing risk); however, it is by no means clear from the literature that such designs result in a materially better return-for-risk trade-off.

Although they differ, target-risk and target-date fund designs share a key similarity: they are both deterministic. Each is deterministic in the sense that the plan participant knows with certainty what the allocation to any asset class will be at any given age, and, importantly, the strategy itself is blind to the objectives of the DC plan participant. We now consider a non-deterministic, target-sensitive alternative: dynamic strategies.

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4 Markowitz (1952) was the first formal, mathematical treatment of what had long been accepted as conventional wisdom. For example, diversification is referred to in both the Bible (“Give a portion to seven, and also to eight: for thou knowest not what evil shall be upon the earth”, Eccles 11:2 D-R) and Shakespeare’s Merchant of Venice.

5 Literally a page later, Merton (1969), in continuous time, confirmed Samuelson’s (1969) constant weight finding in the presence of CRRA, and extended his analysis to consider a constant absolute risk aversion (CARA) assumption.

6 Research has generally found that transitioning to lower risk assets as retirement approaches may help reduce the risk of the most extreme negative outcomes, and reduce the volatility of wealth outcomes, making them desirable for investors who seek a reliable estimate of their final pension in the years prior to retirement (Blake et al., 2001). However, other research shows that these benefits do not come without (sometimes substantial) cost to investors in the form of the sacrifice of significant potential upside wealth accumulation (Booth and Yakoubov, 2004; Byrne et al., 2007; Basu and Drew, 2009). Bodie and Treussard (2007) argue that deterministic TDFs are optimal for some investors, but not for others, based on the investor’s risk aversion and human capital risk.

7 Financial planners may well object here and point out that investments in such DC plan options are merely one piece of their client’s comprehensive retirement plan. That may well be true, but those that design such plan options are not privy to the personal circumstances of the (tens- or hundreds-of-thousands of) thousands of investors in these options. They are, therefore, required to design such options in a vacuum.
In this section of our study, we extend the analysis to a class of dynamic strategies in which the dynamism is dictated by progress against a retirement goal. The dynamic strategies we consider are of the kind examined by Basu et al. (2011), which was in turn based on the work of Blake et al. (2001) who considered incorporating performance feedback in an asset-allocating portfolio design. Such research has generally found that dynamic strategies increase the probability of achieving a given (reasonable) retirement goal with less risk; however, in doing so, these strategies miss out on upside potential. The specific designs analyzed in this paper will be outlined in Data and Methodology (Section 3).

Other research has considered dynamic strategies with real estate in an outcome-oriented paradigm but using a different mechanism to that examined in this paper. For example, Drew et al. (2015) confirmed, using a simulation framework, that dynamic strategies including an allocation to real estate may improve portfolio performance. Importantly, Drew et al. (2015) considered the performance of real estate in portfolios in which the allocation to real estate is a function of monetary conditions during the retirement risk zone. These studies found that “simple decision rules related to the phase of the monetary cycle can outperform more structured TDF strategies over the long term” (Drew et al., 2015, p. 94). In this study, we also analyze dynamic strategies but instead look at decision rules based on performance versus a retirement target. Consistent with the first paper in this series (Drew et al., 2014), we continue to evaluate performance through an outcome-oriented lens (see Exhibit A for a discussion on the retirement adequacy measures employed throughout this paper).

The remainder of the study is organized as follows:

- Section 3 outlines the data and methodology employed. We take a bootstrap simulation approach using historical data to test a range of asset allocations both with and without an allocation to a sleeve of equally allocated public and private real estate. The results of the study are presented in graphical and tabular form.
- Section 4 outlines the range of extant asset allocation designs.
- Section 5 confirms that by adding a blend of public and private real estate to a range of traditional and innovative DC plan portfolios, plan sponsors are able to improve the risk characteristics of a portfolio without affecting performance (and, in some instances, enhancing portfolio outcomes). We also report the results of two different time-varying sub-allocations to public and private real estate over the lifecycle.
- Section 6 offers concluding remarks.

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In this paper, we clearly differentiate between dynamic, target-oriented strategies—which we study—and dynamic asset allocation processes—which we do not. In the former, dynamism is driven by progress toward a specified retirement goal; in the latter, dynamism is a function of a view about the expected returns of asset classes (i.e., a view about current valuations versus some equilibrium expectation). The former is more a matter of DC plan design; the latter, a matter of investment process.
3 DATA AND METHODOLOGY
We take the view that retirement wealth accumulation and subsequent income generation is the true measure of success for DC plan participants (Drew and Walk, 2016). This framing has been supported by Merton (2014) who identified the dangerous shift “from retirement income to return on investment (p.4)” that has accompanied the rise of DC plans globally and has advocated an income-focused investment strategy. Baker et al. (2005) agreed, arguing that DC plans should be measured in terms of their ability to generate sufficient retirement income. If we accept this as the ideal expression of retirement security, DC plans might therefore seek to minimize the shortfall risk of plan participants, for example, over other measures of success. This is no subtle point; changing the measure of success to one framed in terms of income security may lead to very different decisions by plan sponsors (Drew and Walk, 2016).

DATA

To operationalize the research questions considered in this study, we consider four categories of asset classes: Growth (Stocks); Defensive (Bonds); Liquidity (Cash) and Alternatives (Public real estate, “Public RE”, and Private real estate, “Private RE”). We use the following classification to illustrate our approach (Figure 2).⁹

Figure 2 Asset Allocation Classification

⁹ Assumptions regarding management fees are provided in parentheses.
We collated and synchronized the data to derive a series of quarterly returns.\textsuperscript{10} Data were obtained to cover the period January 1978 through to December 2015 (n = 152 quarters). A range of indexes were used to serve as a proxy for the asset class categories:

- Stocks: S&P500 Index return series;
- Bonds: Barclays U.S. Aggregate Index return series\textsuperscript{11};
- Cash: Three-month T-bill yields;
- Public Real Estate: FTSE NAREIT U.S. Real Estate Index return series\textsuperscript{12}; and
- Private Real Estate: NFI-ODCE Value-Weighted Index return series\textsuperscript{13}.

In order to understand the after-fee value proposition of each of these asset classes, we adjust gross returns for an assumed level of fee by asset class.\textsuperscript{14} The summary statistics for the after-fee data is provided in Table 1.

\textbf{Table 1} Summary Statistics (nominal, after-fee, quarterly, 1978-2015)

<table>
<thead>
<tr>
<th></th>
<th>Stocks</th>
<th>Bonds</th>
<th>Cash</th>
<th>Public RE</th>
<th>Private RE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (%)</td>
<td>2.93</td>
<td>1.86</td>
<td>1.15</td>
<td>3.00</td>
<td>1.90</td>
</tr>
<tr>
<td>Stand Dev (%)</td>
<td>6.14</td>
<td>3.23</td>
<td>0.91</td>
<td>6.67</td>
<td>2.69</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.01</td>
<td>1.28</td>
<td>0.55</td>
<td>0.16</td>
<td>-2.89</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>4.05</td>
<td>6.04</td>
<td>-0.06</td>
<td>0.28</td>
<td>12.02</td>
</tr>
<tr>
<td>Jarque-Bera test</td>
<td>129.97</td>
<td>272.13</td>
<td>7.70</td>
<td>1.17</td>
<td>1125.95</td>
</tr>
<tr>
<td>p-value</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.56</td>
<td>0.00</td>
</tr>
<tr>
<td>Max (%)</td>
<td>21.32</td>
<td>18.75</td>
<td>3.70</td>
<td>22.71</td>
<td>6.16</td>
</tr>
<tr>
<td>Min (%)</td>
<td>-26.61</td>
<td>-8.75</td>
<td>-0.04</td>
<td>-14.58</td>
<td>-13.89</td>
</tr>
</tbody>
</table>

The results confirm a positive, largely linear trade-off between risk and reward over the observation period. If we think about what a sleeve of alternative assets might look like (in this study, a 10% sleeve of alternatives comprised of a fixed, equal allocation to public and private real estate), a naïve combination of these two real estate exposures (half and half) offers slightly lower returns and commensurately lower risk than stocks. However, this observation ignores the performance of real estate during contrationary and expansionary monetary cycles, Drew et al., 2015. Figure 3 provides a snapshot of the evolution of $1,000 invested in each of these asset classes over the period January 1978 through to the end of 2015.

\textsuperscript{10} It has been two decades since the publication of the work by Kallberg et al. (1996) that illustrated the important role both public and private real estate can play in portfolio construction. In the tradition of Kallberg et al., (1996), this study also uses quarterly data to evaluate the role of real estate in DC plan design.
\textsuperscript{11} The index represents securities that are SEC-registered, taxable, and dollar-denominated. The index covers the U.S. investment-grade fixed-rate bond market, with index components including treasuries, government-related & corporate securities, MBS pass-through securities, ABS, CMBS securities; must be at least one year to final maturity (ABS > remaining average life of one year), must be rated investment grade or better, and must be publicly issued securities although 144A securities with registration rights are included. These major sectors are subdivided into more specific indexes that are calculated and reported on a regular basis. The lower limit of par outstanding is $250 million.
\textsuperscript{12} The FTSE NAREIT U.S. Real Estate Index series is designed to present investors with a comprehensive family of REIT performance indexes that span the commercial real estate space across the U.S. economy, offering exposure to all investment and property sectors. In addition, the more narrowly focused property sector and sub-sector indexes provide the facility to concentrate commercial real estate exposure in more selected markets.
\textsuperscript{13} The NFI-ODCE Value-Weighted Index is an index of quarterly time-weighted total returns of diversified core equity style open-end funds.
\textsuperscript{14} The following average annual management fee expense ratios have been assumed in the analysis (based on advice from DCREC): Stocks 0.08%; Bonds 0.15%; Cash 0.19%; Public RE 0.10%; and Private RE as per net total returns from the Value-Weighted Index (since inception of 1.07%).
We now consider the degree to which the asset class categories have moved in relation to each other over time. In a theoretical world, investors would seek to combine asset classes with negative correlations to achieve portfolio efficiency. Alas, in the real world, we find that the long-term relationship between the various asset classes is less than unity (≠ +1), but rarely negative (see Table 2). As expected, public (and to a lesser extent, private) real estate has some positive correlation with stocks; however, their respective long-term correlations have been relatively low.

**Table 2** Correlation Matrix (nominal, after-fee, quarterly, 1978-2015)

<table>
<thead>
<tr>
<th></th>
<th>Stocks</th>
<th>Bonds</th>
<th>Cash</th>
<th>Public RE</th>
<th>Private RE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonds</td>
<td>-0.10</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>0.08</td>
<td>0.13</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public RE</td>
<td>0.28***</td>
<td>0.31***</td>
<td>0.05</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Private RE</td>
<td>0.19*</td>
<td>-0.13</td>
<td>0.24**</td>
<td>-0.11</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Note: *, **, and *** denote significance at the 0.05, 0.01 and 0.001 levels, respectively.*
We acknowledge that correlation statistics are not the final word on portfolio risk control, bringing to mind the old adage: in a crisis, the only thing that goes up is correlation. Correlations are dynamic over time and are one of the critical inputs in any mean-variance optimization routine (Markowitz, 1952). To explore risk control in a portfolio context, we conduct a simple unconstrained optimization (without short sales) following Markowitz (1952). Given the attractive reward-for-risk proposition offered by both cash and private real estate—i.e., they are the most “north-west” in Figure 4—we would expect these asset classes to have the highest portfolio weights in an unconstrained optimization. These expectations are borne out in the results. Note we are not making a case for any particular level of allocation to any asset; instead, we are merely highlighting that by combining imperfectly correlated assets (cf. Table 2) in a portfolio it is possible for the investor to obtain an overall better reward-for-risk proposition (black square, Figure 4).

![Efficient Frontier](image)

Figure 4 Mean-Variance Optimization (nominal, after-fee, quarterly, 1978-2015)

It is important at this juncture to discuss some of the limitations of the data used in the study. First, the historical returns presented in Table 1 represent an observation window of just less than four decades (the commencement date of some of the real estate indexes employed in the study). Given this limitation, the simulation method used allows for a wide range of paths to stress test the results (with a particular emphasis on downside scenario paths). While this period of capital market history contains a number of volatile events—such as the Global Financial Crisis—the overall results may appear optimistic, but the future is unknown. In this sense, the usual caveat regarding historical return data applies—that is, historical returns are not necessarily representative of future returns. We return to this specific issue in the upcoming discussion on the simulation approach.
Second, while this research makes some assumptions about management fees, we note it does not fully capture issues relating to other expenses, taxes, manager skill (or otherwise), or the broader challenge of whether the proxies selected are investable (particularly for private real estate). Anecdotal evidence suggests that DC providers use a wide range of approaches to access all asset classes, particularly alternatives. With such a wide range of approaches, it is difficult for us to resolve a single set of assumptions that captures the diversity of approaches in the industry. As such, we favor a research design that allows us to undertake a general, replicable analysis. Management expense ratios (MERs) and fees are known costs that are under intense scrutiny in DC plans, both in the United States and around the world. In a world of fee compression, we would encourage the reader to consider the simulated net results provided in this study and apply their own additional fee adjustments as appropriate. The results section of this study (Section 5) provides a diagram that can help readers determine the nexus between returns, retirement nest eggs and real income replacement.

Third, we acknowledge further opportunities for diversification beyond U.S.-dollar-denominated assets. As outlined, we have favored a number of well-known, commonly-used indexes as proxies for the asset-class categories. Our rationale here is to reasonably capture the opportunity set available for DC plan sponsors to offer to their participants. This is a conscious decision made in the research design phase so as not to distract from the essential trade-off across these categories. Finally, inflation is a key risk facing retirees (Drew and Walk, 2016). All results reported in this study are in real terms (that is, adjusted for inflation).

**HYPOTHETICAL PLAN MEMBER**

A challenge facing all pension finance research relates to the assumptions made regarding the hypothetical DC plan participant, particularly the representativeness of the assumptions. For example, as noted by Basu and Drew (2009), one key feature of DC plan design is the assumption that members have long and continuous periods of employment during which contributions are made. This assumption has led to a debate on the adequacy of DC plans for those with interrupted employment, particularly the adverse effects this has on the wealth accumulation and retirement income prospects for women (Basu and Drew, 2009). While not directly addressed in this study, we would note this as an area for future research and a subject of ongoing debate regarding the retirement security provided by DC plans.

In this study, success (as in Baker et al., 2005; Merton, 2014; Drew and Walk, 2016) is defined as replacing more than 70% of a plan participant’s pre-retirement real income for life (ignoring Social Security income). We acknowledge this is a somewhat arbitrary definition, and the setting at this level may not suit all participants. However, the important work of Poterba et al. (1998) points to the need for retirees to have a nest-egg that can safely provide adequate retirement income as well as account for the cost of inflation throughout their retirement years.

We define a hypothetical DC plan participant as being a 25-year-old with a salary of $40,000 and $7,500 in retirement savings. Our DC plan participant experiences real salary increases of 1% per year and contributes 8.8% of their salary to a DC portfolio on a continual basis through their working life. Our hypothetical participant’s salary in their final year of work prior to retirement is $59,555 in real dollars.\(^{15}\)

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\(^{15}\) Starting salary (at age 25) was obtained from the Bureau of Labor Statistics (BLS, 2016b), based on media weekly earnings (Total, 25-34 years) of $753 per week or $39,156 per annum (rounded to $40,000). The hypothetical plan participant’s wealth at age 25 is based on Employee Benefit Research Institute (EBRI, 2016) data for median 401(k) plan account balances for those plan participants aged in their 20s with a salary range that includes our assumed salary of $40,000. The median plan balance for this demographic is $7,474, or $7,500 rounded (EBRI, 2016, p. 20, Fig. 16). Real earnings growth was 1.3% for the year to August 2016 (BLS, 2016a). Adjusting for the average decrease in the average workweek, real earnings grew at 0.4% per annum. Based on this data, we assume a conservative real salary growth rate of 1% per annum. Finally, we assume a total contribution rate (both employee and employer contributions) of 8.8% based on median savings data obtained from Vanguard (2016, p. 4). The final salary of $59,555 is the salary obtained by growing the starting salary of $40,000 at the real salary growth rate of 1% per annum.
We use the retirement wealth ratio (RWR)—the ratio between the final year’s salary of our hypothetical plan participant and their final DC plan account value—as the key performance metric for the simulation (see Exhibit A for a technical discussion of the measures used in this study). We define the annuity equivalent value (AEV) as the real annual income that can be sustained assuming a 30-year drawdown phase and a 2.5% constant return.

An RWR of 15x (specifically, 15.2-times) would replace more than 70% (actually, 73%) of our hypothetical plan participant’s final year salary for a retirement period of 30 years, ignoring any income from Social Security. It is our belief that the RWR is an appropriate method for defining success because it is a tangible outcome-oriented measure that is easily converted into an AEV expressed in real dollars. In practical terms, the RWR provides a useful heuristic for DC participants in that it expresses retirement savings as a multiple of their final year’s salary—regardless of the salary level. In this sense, the measure provides a universal benchmark. Such a measure changes retirement savings from being thought of as the proverbial pot of gold and into a matter concerned with the sustainability (or lack) of real lifetime retirement income.

**SIMULATION APPROACH**

When considering how best to simulate future returns, we are reminded of Yogi Berra’s much quoted epithet: “It’s tough to make predictions, especially about the future.” The distributional characteristics of the asset class categories considered in this study suggest that returns do not always conform to a normal distribution. Alternatively, the distribution of returns is generally non-Gaussian; recall the Jarque-Bera test results reported in Table 1. The authors have sympathy for the argument that past returns may not be indicative of future returns. Some commentators have argued that quantitative easing has driven up the price of stocks, bonds, real estate and other assets to a level “without historical precedent.” If that is the case, having even a century of historical return data for all our asset class categories may be of limited use. We postulate that the considerable uncertainty regarding future asset returns makes Mr. Berra’s logic even more apropos for this study.

Given the uncertain nature of this issue, we have erred on the side of pragmatism in this study and favored simplicity over complexity. We employ a data-driven, bootstrap approach to simulation, popularized by Bradley Efron of Stanford University. We employ the non-parametric i.i.d. bootstrap proposed first by Efron (1979). This technique allows examination of some extreme paths using quarterly blocks. As a practical example, the simulation method may result in multiple repetitions of asset class returns from the third quarter 2008 (recall Lehman Brothers filed for Chapter 11 on September 15, 2008). Conversely, some simulations that are surprising on the upside accompany these newly simulated ‘bad’ paths (some of the worst paths record an average real return of only 1% per annum over a 40-year period, see Section 5). Again, with a hat tip to Mr. Berra, when simulating investment returns, caveat emptor.

Each scenario was simulated using bootstrap sampling 10,000 times to replicate the empirical distribution of the respective asset classes. The convergence of results for each set of simulations was cross-checked to ensure stability. In practice, only several thousand simulations were required to achieve convergence. Again, it is important to note that all values reported are in real inflation-adjusted terms.

We now turn to the issue of exploring various asset allocation approaches or strategies in DC plans prior to reporting our key findings.

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16 The terminal wealth of the hypothetical plan participant in this analysis is $905,797 (in real terms), while the corresponding 30-year annual equivalent value (AEV) is $43,277 per annum.
17 By way of example, see the debate in the Wall Street Journal, via http://www.wsj.com/articles/the-federal-reserve-asset-bubble-machine-1431386994.
18 The technique derives from the phrase “to pull oneself up by one’s bootstraps”, attributed to Rudolf Eric Raspe’s novel “The Adventures of Baron Munchausen.”
19 Independent, identically distributed (i.i.d.) observations.
20 Recall also that we are simulating from quarterly blocks (not from daily or monthly returns, leading to less ‘noise’ in the results.
21 For those wishing a more fulsome discussion of the competing approaches to simulation, see the first paper in this series, specifically, pp. 9-10 (Drew et al., 2014).
EXHIBIT A – RETIREMENT ADEQUACY MEASURES

The challenge with return- or dollar-based terminal wealth measures of performance is that neither is particularly informative for the investor in terms of what performance means for their spending power in retirement. Baker et al. (2005), for example, argued that DC plans should be measured in terms of their ability to generate sufficient retirement income, and Booth and Yakoubov (2000) and Basu and Drew (2009, 2010) contended that a plan participant’s expectations will somehow be related to their salary immediately prior to their retirement. Therefore, we adopt Basu and Drew’s (2009, 2010) retirement wealth ratio \( RWR_T \), which is calculated by dividing terminal wealth \( W_T \) by income at retirement (i.e., at time \( T \)). The \( RWR_T \) provides a way of relating terminal wealth to a quantifiable benchmark for the participant’s post-retirement expectations.

Another advantage of \( RWR \) is that it normalizes expectations across income groups. For example, a high-income earner and a low-income earner can both relate to \( RWR \) of, say, 15 times final salary because it allows for their different dollar expectations based on their respective incomes. Put another way, two individuals could be targeting the identical \( RWR \) but wildly different levels of terminal wealth by virtue of the fact that their incomes are different.

Finally, an existing study relating to the role of real estate in DC investing—Esrig et al. (2013)—uses a version of the \( RWR \) described as the “ending value multiple of final year wages” (cf. Exhibits 5-6, p. 149, of that study). In this way, this measure has precedent in the literature relating to the central question of this study.

If we assume income is required for 30 years in retirement \( (n) \), and a real interest rate \( (r) \) of 2.5% per annum, we can compute the real replacement rate \( (RR) \) consistent with \( RWR \) of 15.2 (via an annuity equivalent value \( (AEV) \) calculation) as follows,

\[
real \ AEV = \frac{r(W_T)}{1 - (1 + r)^{-n}}
\]

Let us assume that if final salary equals $1 and terminal wealth = $15.20 so that the retirement wealth ratio at retirement \( RWR_T = 15.2 \) times then,

\[
real \ AEV = \frac{0.025(15.20)}{1 - (1 + 0.025)^{-30}} = 0.7262 = 0.73
\]

\[
real \ RR_T = \frac{0.73}{1} = 73\%
\]

The thresholds used in this study, in \( RWR \) and \( RR \) terms, are the equivalent of an \( RWR \) of 15.2 times and a replacement rate of 73%.
4 ASSET ALLOCATION
Asset allocation funds (both age-based and objective-based) are the backbone of today’s DC plan investment menus. How we approach the issue of portfolio construction—whether lifecycle or target date, balanced funds and/or managed accounts—plays a key role in determining ultimate retirement security (Brinson et al., 1986). In this study, we consider three approaches to portfolio construction in DC multi-asset portfolios, specifically: deterministic strategies; dynamic strategies; and, sub-allocation strategies.

For purposes of comparability across the three approaches, we examine four distinct time periods or “partitions” over the DC participant’s lifecycle, specifically:

- Partition 1: from age 25 through age 50;
- Partition 2: from age 51 through age 55;
- Partition 3: from age 56 through age 60; and
- Partition 4: from age 61 through to the assumed retirement age of 65.

Consistent with our discussion of factors that affect retirement outcome in Figure 1, we visualize the four partitions in Figure 5. Partition 1 is the period over which time-weighted returns are most important (cf. brown series) and, as a result, all strategies have relatively high allocations to growth assets over the course of this partition. Note that partitions 2 through 4 cover the time periods over which sequencing risk rises rapidly (cf. blue series) and when dollar-weighted returns (cf. red series) are paramount. We will investigate all asset allocation strategies in this study from the perspective of these four partitions.

For completeness, we have also considered pure play allocations (100% growth and 100% defensive) as well as the much debated 1/n heuristic (sometimes referred to as the ‘1/n rule’), (Gigerenzer, 2008; DeMiguel et al., 2009). In the interests of brevity, these results are omitted from the study.

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Figure 5 Panel B – Descriptions of Four Time-Period Partitions

For consistency, we present the asset allocation designs in this study to reflect these four key lifecycle partitions (by way of example, see Figure 6 below).

[RQ1] DETERMINISTIC STRATEGIES

Target-Date Fund Options

- TDFs provide a simple, automated approach to retirement savings/investing in DC plans. Three different kinds of TDFs are considered in the study, with each glide-path design commencing the process of de-risking from age 50 across three partitions (51 to 55; 56 to 60; 61 to 65).
- The three TDF designs in this study are examined with and without real estate.
  - TDF1 takes a growth-oriented approach, commencing with 80% growth/20% in defensive assets moving to 40% growth/50% defensive/10% liquidity assets at retirement.
  - TDF1 RE follows the same path, but adds a 10% sleeve of real estate (a constant blend of 50% public and 50% private real estate). Equal proportions of 5% are taken from growth (stocks) and defensive (bond) assets to facilitate the real estate allocation.
In addition to TDF1/ TDF1 RE, two further TDF designs are considered. These take the form of a more balanced (TDF2/ TDF2 RE) and conservative (TDF3/ TDF3 RE) glide path design (and are illustrated in Appendix 1).

- TDF2 commences with 60% growth/ 30% defensive/ 10% liquidity moving to 42% growth/ 58% defensive at retirement. TDF2 RE follows the same path but adds a fixed 10% sleeve of real estate, again made up of half public and half private real estate.
- TDF3 commences with 55% in growth/ 35% defensive/ 10% liquidity assets moving to 20% growth/ 70% defensive/ 10% liquidity at retirement. Again, TDF2 RE follows the same path, but adds a 10% sleeve of real estate.
**Target-Risk (or Balanced-Style) Fund Options**

- We examine three types of target-risk strategies, both with and without real estate.
- TRF1 take is an aggressive-style fund, holding a constant 80% growth/10% defensive/10% liquidity allocation. The comparison fund, TRF1 RE, follows the same path with the addition of a 10% sleeve of real estate.
- TR2F is a more balanced-style target-risk option with a constant 60% growth/20% defensive/20% liquidity mix. TRF2 RE adds a sleeve of real estate (illustrated below).
- Finally, TRF3 takes a more conservative approach, with a mix of 40% growth/30% defensive/30% liquidity, with TRF3 RE as the comparison fund.

**Figure 7 TRF2 and TRF2 RE**
[RQ2] DYNAMIC STRATEGIES

Dynamic Lifecycle Funds
The dynamic strategies studied in this paper are similar to those studied by Basu et al. (2011) and Drew et al. (2014) in that they employ a dynamic asset allocation process informed by a pre-determined real-return target. In short, the dynamic strategy keeps risk “on” when below a specified target (similar to a target-risk fund) and turns risk “off” when real returns are above the target (a target-date fund) in the last 15 years of a participant’s working life.

To measure the effect of adding allocations of real estate in each of the dynamic strategies, we compared the effect of an outcome-informed asset allocation on terminal wealth (measured by RWRs and resultant AEVs). As previously defined, a dynamic strategy keeps risk on when below a specified real-return target threshold and lowers risk when above that threshold (the latter following the de-risking approach of a target-date fund in the last 15 years of a participant’s working life). We have stated throughout the study that ‘success’ is achieved when a DC participant can replace around 70% of their pre-retirement income (defined as their final year salary) for life (defined as 30 years of real income). Given the assumptions around our hypothetical participant (starting salary, real salary growth, contribution rates and number of years employed), a real rate of return of about 6.5% is required to achieve this outcome (that is, RWR of around 15x final salary). Finally, we explore three different dynamic lifecycle (DLC) designs:

- DLC1 – As per Figure 8, the threshold is a real rate of return of 6.5% per year; if below that target, the portfolio switches to a more aggressive 90% growth (stocks) / 10% liquidity (cash). The comparable portfolio with real estate is identical, apart from adding a sleeve of 10% throughout the lifecycle and having a below target portfolio 90% stocks /10% real estate (that is our equally weighted real estate allocation). Note that DLC1 is identical to TDF1 until age 50 and then takes a more dynamic approach in the last 15 years of working life. This is, of course, dependent on how the participant’s account balance is progressing toward their stated RWR target of 10x.
- DLC2 – The threshold real rate of return is 5.5% per year (with the risk “on” portfolios as per DLC1 post age 50).
- DLC 3 – The threshold real rate of return is 4.5% per year (with the risk “on” portfolios as per DLC1 post age 50).

Again, see Appendix 4 for an illustration of DLC2/ DLC2 RE and DLC3/ DLC3 RE.

The basic mechanics of DLC1 (and DLC1 RE) are illustrated in Figure 8.
### Figure 8 DLC1 and DLC1 RE

<table>
<thead>
<tr>
<th>PARTITION</th>
<th>PARTITION 1</th>
<th>PARTITION 2</th>
<th>PARTITION 3</th>
<th>PARTITION 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>25</td>
<td>...</td>
<td>50</td>
<td>51</td>
</tr>
</tbody>
</table>

**DLC1**

- If RW_1 < RW_0
  - If RW_2 < RW_0
    - If RW_3 < RW_0
      - If RW_4 < RW_0

- If RW_1 > RW_0
  - If RW_2 > RW_0
    - If RW_3 > RW_0
      - If RW_4 > RW_0

**DLC1 RE**

- If RW_1 < RW_0
  - If RW_2 < RW_0
    - If RW_3 < RW_0
      - If RW_4 < RW_0

- If RW_1 > RW_0
  - If RW_2 > RW_0
    - If RW_3 > RW_0
      - If RW_4 > RW_0

Legend:
- Stocks
- Bonds
- Cash
- Public Real Estate
- Private Real Estate
[RQ3] SUB-ALLOCATION STRATEGIES

Real Estate Public and Private Mix

Keeping the aggregate allocation to real estate fixed throughout the DC participant’s investment life cycle, we hypothesize that the actual allocation between public and private real estate may have an impact on both terminal wealth and expected shortfall outcomes for various portfolio strategies. Using a variety of blending methods, we test terminal wealth and expected shortfall results. In particular, we test whether a blend that increases its allocation to private real estate assets over the lifecycle outperforms an alternative blend that increases the allocation to public assets. Likewise, we examine how these blends impact RWR shortfalls.

The actual mix of public and private real estate is hypothesized to have some impact on both the terminal wealth and expected shortfall outcomes of DC investment portfolios. Again, we apply the Efron bootstrap simulation process using a range of real estate blends as follows:

- Blend 1 (increase to private real estate): 10% public declining to 0%; and 0% private increasing to 10% gradually over the full time horizon; and
- Blend 2 (increase to public real estate): 10% private declining to 0%; and 0% public increasing to 10% gradually over the full time horizon.

Figure 9 Real Estate Allocations Through Time

In this section of the analysis, we used the framework established in DLC1/DLC1 RE to explore these ideas. The intent was to hold the overall real estate allocation constant at 10% and explore the impact of different approaches to sub-asset class exposures throughout the lifecycle (as in Figure 9). Next, we turn to the major findings of the analysis.
5 RESULTS
The challenges of designing optimal DC investment options are hardly trivial for DC plan sponsors and their investment advisers. They must consider far more than simply creating asset allocation pie charts and drawing a glide path. We believe, however, that these are actually secondary issues. The much more difficult challenges relate to matters such as investment beliefs (what are the best ways to approach portfolio construction and asset selection?); mission clarity (what is ‘success’ for our DC plans?), and, following implementation of the strategy, ongoing monitoring and review (how can we insure that we are on the right track?). As Drew and Walk (2016) and others have emphasized, it’s the destination that matters in DC portfolio design.

Given the number of portfolios and comparables examined and thousands of paths simulated in our analysis, using visualization of the results will allow for a deeper dive into the key themes. We summarize the results of the analysis under the three research questions considered in the study, specifically:

- [RQ1] Deterministic strategies;
- [RQ2] Dynamic strategies; and
- [RQ3] Sub-allocation strategies.

As discussed previously, the key metric in this study is the RWR. We have established minimum success as replacing about 70% of our hypothetical plan participant’s pre-retirement income (inflation-adjusted for life, or RWR of 15x – which is shaded in GREY). Figure 10 provides a way of equating final RWR, to average annual real rates of return and the associated real replacement ratio.

**Figure 10** Real Retirement Income
When considering the following pages of results, please note:

- Portfolios without real estate are shaded RED (for instance, red denotes TDF1 RWR outcomes through to retirement), while portfolios with real estate are shaded BLACK (TDF1 RE). These diagrams are on the left side panel. The RWR of 15x is shaded in GREY.
  - We are interested in the trade-off between median values and the spread of outcomes across competing asset allocation strategies.
  - We believe that plan participants, ceteris paribus, would prefer a similar (or higher) median outcome with a narrower distribution (particularly downside risk, see arrow). This corresponds to a narrower range of simulated outcomes that meet (or exceed) the RWR objective (and resultant replacement rate).

- The diagrams on the left hand side panel show the range of outcomes. For simplicity, we summarize these (many) simulated results into a simple cumulative distribution function (CDF) to ascertain the chance of different asset allocation strategies meeting or exceeding our RWR target of 15x (equivalent to a RR of 73% for our hypothetical plan member).

- On the right-hand side panel is the CDF of the RWRs.
  - The same color schemes apply, as previously defined (RED, BLACK and GREY).
  - We are interested in the probabilities of achieving (or exceeding) a 15x RWR (see brackets, prefer a high probability).
  - We argue that plan participants would prefer a lower CDF (as this corresponds with a higher probability of achieving, or exceeding, a stated RWR target).
[RQ1] DETERMINISTIC STRATEGIES

Target Date Funds

- Strategy without RE (red) has a wider distribution, on both upside and downside.
- Strategy with RE (black) has a better chance of meeting or exceeding 15x RWR.
- Lower risk strategy means fewer paths exceed the retirement target of 15x RWR.
[RQ1] DETERMINISTIC STRATEGIES

Target Risk Funds
[RQ2] DYNAMIC STRATEGIES

Dynamic Lifecycle Funds
Table 3 Summary Results

This matrix represents the Bottom 5th percentile, Condition Value at Risk (CVaR) and median annual equivalent value (AEV, in dollars), as well as retirement wealth ratios (RWR, in times final salary) for our hypothetical DC participant under each of the asset allocation strategies, with and without real estate, in real terms.

<table>
<thead>
<tr>
<th>Target Date Fund Options</th>
<th>At Retirement Date (with Real Estate)</th>
<th>At Retirement Date (without Real Estate)</th>
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<tbody>
<tr>
<td></td>
<td>Bottom 5th Percentile1</td>
<td>CVaR2</td>
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<tr>
<td>TDF 1</td>
<td>AEV</td>
<td>40,221.57</td>
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<td></td>
<td>RWR</td>
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<tr>
<td>TDF 2</td>
<td>AEV</td>
<td>39,090.81</td>
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<tr>
<td></td>
<td>RWR</td>
<td>10.69</td>
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<tr>
<td>TDF 3</td>
<td>AEV</td>
<td>36,793.10</td>
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<tr>
<td></td>
<td>RWR</td>
<td>10.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target Return Fund Options</th>
<th>At Retirement Date (with Real Estate)</th>
<th>At Retirement Date (without Real Estate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bottom 5th Percentile</td>
<td>CVaR</td>
</tr>
<tr>
<td>TRF 1</td>
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<td></td>
<td>RWR</td>
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<td></td>
<td>RWR</td>
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<td></td>
<td>RWR</td>
<td>8.97</td>
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<table>
<thead>
<tr>
<th>Dynamic Lifecycle Fund Options</th>
<th>At Retirement Date (with Real Estate)</th>
<th>At Retirement Date (without Real Estate)</th>
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<tbody>
<tr>
<td></td>
<td>Bottom 5th Percentile</td>
<td>CVaR</td>
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<tr>
<td>DLC1 (Growth)</td>
<td>AEV</td>
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<tr>
<td>DLC2 (Balanced)</td>
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<td></td>
<td>RWR</td>
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<td>DLC3 (Conservative)</td>
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<tr>
<td></td>
<td>RWR</td>
<td>10.39</td>
</tr>
</tbody>
</table>

Notes: *Bottom 5th Percentile is representative of the 500th worst outcome out of 10,000 trials. *Conditional Value at Risk is representative of the average of the Bottom 5th Percentile.

Major themes to emerge from the analysis:

- In each of the designs, the addition of a 10% sleeve of real estate to portfolios (a fixed blend of half public and half private real estate) typically provide comparable median outcomes for diversified portfolios, with a narrower distribution of RWRs at retirement. This equates to a smoother ride to the destination.
- The narrower distribution of outcomes is confirmed in the cumulative distribution function (CDF) plots, which show that at the 15x RWR level, the addition of real estate is accretive to meeting or exceeding retirement income objectives (i.e., the probability of achieving the targeted RWR for those lifecycle strategies with real estate are higher than those of their counterparts without real estate).
The results confirm the old adage that you would prefer to be in target-date funds if markets are generally bad (risk “off”) over the last 15 years of your working life and be in target-risk or balanced-style funds if markets are generally good (risk “on”) over this period. The outcome-oriented approach of dynamic lifecycle funds seems promising, as it considers the glide path as a channel, in which risk is on or off as a function of a predetermined real-return objective.

While these results are encouraging, it is important to note the upside potential is limited as we move beyond a 15x RWR level. This loss of upside benefits could be considered as the price (or opportunity cost) of adding an allocation to real estate to the portfolio. Alternatively, participants achieve a tighter distribution of outcomes with less downside risk when the real estate allocation is included.

We also note that when markets are bad, retirement outcomes are bad. In DC plans, participants bear all of this risk. Some of the worst outcomes would see participants achieving RWR of less than three times final income (equivalent to an average real return of around 1% per annum or a real replacement rate ratio of 13%, ceteris paribus). As discussed previously regarding this simulation approach, the non-parametric i.i.d. bootstrap methodology has resulted in some gloomy potential paths late in the accumulation phase.

[RQ3] SUB-ALLOCATION STRATEGIES

Finally, we explore whether there are benefits to being more dynamic in the way we sub-allocate to real estate over the lifecycle. In Figure 9, we examined two real estate blends, holding the overall allocation to real estate constant at 10%: Blend 1 had a rising allocation to private real estate and a falling allocation to public real estate, while Blend 2 had the opposite. Figure 11 depicts the simulated paths for these two sub-allocation alternatives.

Figure 11 Real Estate Blend Funds – Wealth Paths
Our results suggest if investors prioritize upside potential, they would tend towards a rising allocation to public real estate and falling allocation to private real estate (DLC1 Blend2 in Figure 11). However, if downside risk is the priority, it may be beneficial to allocate more heavily to public real estate early in the lifecycle—which increases time-weighted returns ceteris paribus—and switch to a greater private real estate allocation as the retirement date approaches (DLC1 Blend1). This finding is consistent with our intuitive reasoning that private real estate—by virtue of its unlisted nature—has risk-management benefits, particularly as a DC plan participant transitions through partitions 2 through 4 (cf. Figure 5).

Figure 12 shows the simulated distribution of outcomes for all permutations of the DLC1 strategy. From this, we can see the three features of DLC1 Blend 1:

- More consistent outcomes around the center of the distribution;
- Improved downside (i.e., better, though not perfect, left-tail characteristics); and
- Some foregone upside (at the right end of the distribution).

Furthermore, the three strategies with allocations to real estate out-perform the strategies without real estate. This confirms the findings of our previous research.

**Figure 12** Real Estate Blend Funds – Probability Distribution Functions
An additional caveat is important here. Recall we are operationalizing this idea using a DLC1 and DLC1 RE framework. Many other permutations could be tested. The reader is also reminded that we are analyzing the impact of this decision to the participant’s normal retirement date; however, we would encourage future research to consider these questions through the retirement date.

These preliminary results raise another important issue for plan sponsors. Clarity is critical about not only the rationale for why a particular asset class is favored, but also about the characteristics and interplay of the sub-allocation strategy. Here, that specifically relates to public versus private real estate mix across the lifecycle.

It is important to recall that we have kept the overall allocation to real estate through the lifecycle at 10% of the total asset allocation and used a DLC1/ DLC1RE framework. The results suggest that allocating to public real estate in the earlier years provides a further diversified growth driver to the portfolios, with the sleeve shifting to more private real estate later as the DC participant approaches retirement. This is not a recommendation to design a lifecycle portfolio this way; rather, we are suggesting that plan sponsors and their investment advisers may want to carefully consider the impact of decisions relating to sub-asset class exposures throughout the lifecycle.

Nevertheless, the case for adding a relatively small sleeve of real estate to DC multi-asset portfolios is relatively strong across both deterministic and dynamic glide-path designs. The preliminary results presented here also suggest there may be merit in implementing a more dynamic approach to allocations at the sub-asset class level for real estate. In practice, a need will always exist for both public and private real estate in DC investment portfolios, as plan sponsors must address the needs both younger and older plan participants.
CONCLUDING REMARKS
This analysis has led us to several higher level conclusions that have implications on the investment menus of DC plans.

**The Case for Real Estate Stands**
The work of Kallberg, et al. (1996) two decades ago considered the role of public and private real estate in the portfolio allocation process. Much of the research since then has corroborated their essential findings that real estate has a solid place in investment portfolios. This paper again underscores the portfolio benefits of real estate in a DC investment context when evaluated through an outcome-oriented lens.

Furthermore, we see tentative evidence that non-constant allocations to public and private real estate throughout the lifecycle may assist plan sponsors and their fund managers in improving DC plan outcomes.

**The Destination Matters**
While our analysis supports the case for real estate, it does so with a somewhat arbitrary retirement target of 15x final salary, replacing around 70% of final salary. This goal should not be taken for granted. Higher or lower retirement targets will have significant implications for DC portfolio structures. Plan sponsors need to devote an appropriate amount of time deciding on this important goal and insure that the investment process is engineered and aligned to achieve this outcome.

While we have focused on returns in this paper, pension finance involves a larger number of variables. These include contribution rates, financial literacy, and time horizon—to mention only a few.

**Risk for Plan Participants Isn’t What You Think It Is**
If the destination to the desired retirement wealth ratio is what matters, then falling short of an appropriate, sustainable retirement-income level (given some combination of contributions and portfolio settings) is the key risk to be managed. The conversation needs to be changed to focus DC participants on this risk, rather than on interesting but much less critical issues such as measured standard deviation and quarterly performance versus peers.

**Dynamic Problems Require Dynamic Solutions**
Very little in the investment world remains static. Our analysis illustrates that a dynamic, outcome-oriented approach can assist in achieving the retirement goals of DC participants. Plan sponsors also need to be mindful of the dynamism of human capital throughout the lifecycle, as well as the heterogeneity of participant needs and behaviors.

**The Importance of Where You Start**
In what could be described as a challenging period for investment markets—with record low, and in some cases negative, real interest rates around the world—valuations clearly matter. Valuation-driven processes that take into consideration prevailing asset prices may offer plan sponsors a way to manage risks and enhance return. These issues are complicated further by the fact that DC plans need to provide investment portfolios across the lifecycle, with older members being less able to withstand risks to their retirement nest-egg (sequencing risk).

**Final Note**
We trust this study has provided DC plan sponsors and their investment advisers and consultants with a framework for taking a more dynamic approach to allocating to real estate assets across the lifecycle of DC portfolios. As our analysis has demonstrated, injecting real estate into the DC lifecycle can effectively improve retirement outcomes while mitigating risk. The benefits are only improved through a dynamic allocation both within the asset allocation and real estate sub-allocation. DC participants are the primary beneficiaries of this approach. For further information on this or related topics, please visit our website at www.dcrec.org.


### APPENDIX 1

**[RQ1] Deterministic Strategies**

*Target-date Fund Options*

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**Chart Notes:**
- **Stocks**
- **Bonds**
- **Cash**
- **Public Real Estate**
- **Private Real Estate**

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*DCREC*

*Drivers, Contributions, Real Estate Council*
[RQ1] Deterministic Strategies
Target-Risk (or Balanced-Style) Fund Options

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- Stocks  - Bonds  - Cash  - Public Real Estate  - Private Real Estate

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- Stocks  - Bonds  - Cash  - Public Real Estate  - Private Real Estate
**APPENDIX 3**

[RQ2] Dynamic Strategies

*Dynamic Lifecycle Funds*

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**Legend:**
- **Blue:** Stocks
- **Red:** Bonds
- **Gray:** Cash
- **Green:** Public Real Estate
- **Dark Green:** Private Real Estate
[RQ2] Dynamic Strategies

Dynamic Lifecycle Funds (Cont...)
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